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Release of MCNP5_RSICC_1.30

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INTRODUCTION

In July of 2004, an updated version of MCNP5™ (MCNP5_RSICC_1.30) was released to the Radiation Shielding Information Computational Center.^{1,2} This updated version has three new features, thirteen bug fixes and several minor coding improvements. The new features are: support for 8 byte integers, specialized tally treatment of large lattices, and mesh tally enhancements. Of the thirteen bug fixes, only four resulted in incorrect answers in specific circumstances. In addition to the standard RSICC distribution of the MCNP5 source, executables and patches, the patch file (only) is available on the MCNP website: <http://www-xdiv.lanl.gov/x5/MCNP/thesources.html>

NEW FEATURES

The three new MCNP5 features are discussed in the following paragraphs. Several new improvements have also been made to the manual and development environment. All of the features, bug fixes, coding improvement issues and related documentation are now maintained in Sourceforge³. Fortran and C source code and regression test problems are now under version control with CVS.

8 Byte Integer Support

There have been occasional requests on the mcnp-forum from users who wish to run more than 2.1 billion particles to improve their tally statistics. In the updated version of MCNP5, twenty-five integer variables are now explicitly declared as 8 byte integers. Most of these variables are related to NPS, the number of histories, and allow users to run more than 2.1 billion source particles. Besides the NPS card in the MCNP input deck, the other cards which allow some 8 byte integer entries are: PRDMP, RAND, PTRAC and MPLOT. These entries control how frequently file dumps and parallel communication rendezvous occur, random number parameters, particle track file generation, and tally plot frequencies, respectively. Additionally, format statements

in the output files were expanded to print allowed 8 byte integers in fields of twelve characters, or up to 999 billion. Since longer MCNP runs can cause larger ptrac files to be created, ptrac files larger than 250 Gigabytes were created and tested.

Lattice Tally Enhancements

In some medical physics radiation transport applications, lattices, often based on CT images, are used to represent human geometry. These calculations, particularly for large lattices, are very time consuming. Lattice tally enhancements included in this release of MCNP5 reduce wall-clock runtimes by orders of magnitude⁴ for these specific problems. MCNP5 also has the capability of determining if the input deck meets stringent requirements necessary to use the lattice speed tally treatment. If so, MCNP5 will issue a warning and will automatically use the enhancement. A new card, SPDTL, can also be used to turn this treatment on or off, and to print out which requirements are not fulfilled, if any.

Mesh Tally Enhancements

The original release of MCNP5 in June 2003 contained support for mesh tallies, or a 3-D grid which calculates volume-averaged fluxes in each voxel in that grid. Included with this feature was the ability to use the tally multiplier card (FM card) in combination with a mesh tally. On the FM card, the user must specify the material whose data are used to calculate the tally values. These data were used over the entire mesh, even if the particle was traveling in a material other than that identified on the FM card. This prevented the calculation of material dependent quantities such as k_{eff} and particle production rates in mesh tallies that range over several materials. This drawback has been rectified in this new version of MCNP5. If zero is entered as the material number on an FM card containing a multiplier set, the reaction data for the material in which the particle is traveling is used to calculate the tally values.

BUG FIXES

Thirteen bugs were fixed in the new update. Only four of these bugs caused incorrect answers in specific circumstances. These four bugs apply to the use of

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DXTRAN spheres in lattices, incorrect interpolation in DE DF cards applied to mesh tallies, incorrect material usage for FM cards with mesh tallies, and attenuator or special multiplier sets with the FM card and mesh tallies. Other bug fixes correct crashes resulting from transforming macrobodies, reading runtpe files incorrectly, and incorrect allocation of the variable ibnk. Two warning messages have also been corrected. A full bug fix list is in the patch documentation².

CODING IMPROVEMENTS

Slight changes have been made to the code and build system to continue to modernize MCNP. Support for outdated Windows graphics interface, Winteracter, has been removed. Plotting on all platforms is now only supported with X11 graphics. More named constants have been added and more real number constants have been forced to double precision. Support for the Intel 7.1 compiler in sequential plot mode on Windows PCs was also added.

FUTURE RELEASES

Currently under development is the next version of MCNP, MCNP6. This version will contain charged particle transport, magnetic field tracking, and other new features. This version is not expected to be released for at least another year. Patches with bug fixes and possibly new features for MCNP5 will be released in the meantime.

REFERENCES

1. X-5 Monte Carlo Team, "MCNP – A General Monte Carlo N-Particle Transport Code, Version 5, Vol. 1" Los Alamos National Laboratory, LA-UR-03-1987 (April 2003).
2. X-5 Monte Carlo Team, "Patch to Update MCNP5 version MCNP5_RSICC_1.20 to version MCNP5_RSICC_1.30," Los Alamos National Laboratory, LA-UR-XXXX (July 2004).
3. <http://sourceforge.net/index.php>
4. T. GOORLEY, "MCNP5 Tally Enhancements for Lattices," Los Alamos National Laboratory, LAUR-04-3400 (May 2004).